AGRONOMY BULLETIN

Fall Nitrogen Management

Fall-applied nitrogen can be an excellent way to provide the nitrogen a crop needs. Any option for applying nitrogen in the fall will have the benefit of allowing planting to start immediately in the spring without having to wait for a fertilizer application ahead of the planter. Fertilizer prices are also often considerably cheaper in the fall as compared to in-season pricing. Anhydrous ammonia is a common fall-applied nitrogen that is often significantly cheaper on a per pound of nitrogen basis.

There are risks and drawbacks associated with fall-applied nitrogen. The largest risk is nitrogen loss through denitrification, leaching, and possibly volatilization. There are ways to mitigate some of these risks, but extreme caution should be taken if conditions are not optimal for making the application.

Factors to Consider:

- **Temperature:** When applying nitrogen in the fall, it is critical to consider soil temperature. Any soil temperature above 50°F/10°C is too warm for nitrogen applications as the soil microbiology is too active and will convert the nitrogen from a stable form into a form that can be easily lost.
- **Soil Moisture:** Soil moisture considerations may be tricky as there can be problems with a soil that is too wet or too dry. Excessively wet soils can have issues with sidewall compaction. It may be difficult to close the application zone if soils are too wet, which can result in nitrogen loss. Excessive water on a coarse textured soil can have a higher potential for leaching losses.

  Extremely dry soils can be difficult to close up too, depending on the soil structure. Anhydrous ammonia can have issues if there isn't enough water in the soil profile to interact with the nitrogen molecules. Anhydrous ammonia is hydrophilic, or water-loving, and will remain in a gas state that can be lost to the atmosphere without water molecules to bond with.
- **Soil Type:** A key consideration when considering fall-applied nitrogen is what type of soils will be receiving the nitrogen. Soils with coarse texture, usually sandier soils, will have more difficulty holding water, and will usually have lower organic matter and lower cation-exchange capacity (CEC) due to lower clay content. Because of this, it is more difficult to hold nitrogen in a stable condition for an extended period of time.

  Heavier soils, with higher clay contents and higher CEC values, generally are better at holding all forms of nutrients. Soils with higher organic matter values also do better holding nutrients. Organic matter is one of the easiest factors to change through management practices.

- **Application Type:** The application method used can have a huge affect on how the nitrogen responds in the soil:
    - **Strip Till:** Strip till consists of applying fertilizer into a strip in the fall so that in the spring, the planter will plant on top of or near the fertilizer strip. Often the strip will be made with a shank, 5 -7 inches deep, and will create a band of fertilizer directly in the root zone. Newer strip-tillers use a wavy coulter in line with the fertilizer tube that will deposit fertilizer at a shallower depth.
    - **Anhydrous Ammonia:** Anhydrous ammonia is usually applied with a tool bar in a similar fashion to strip till. Care needs to be taken to ensure that the strip is closed up well and that there is adequate moisture.
    - **Broadcast:** Broadcast application in the fall can be done, but is the least desirable option for a fall application. Fertilizer placed at or near the soil surface can be subject to greater loss from denitrification, volatilization, and even surface runoff. Broadcasting should only be considered if applying only a portion of the needed nitrogen followed by a higher in-season application. It is highly recommended that a nitrogen stabilizer be used with any of these application options, but especially with a fall-applied broadcast.
- **Nitrogen Stabilizers:** There are four types of nitrogen stabilizers that can be used to help mitigate the loss of nitrogen:
    - **Nitrification Inhibitors:** These products slow down the process of NH_4+ being converted to NO_3-. Both forms of nitrogen are usable by the plant, but NO_3- is less stable in negatively charged soil.
    - **Urease Inhibitors:** These products work specifically on the urease enzyme. The urease enzyme is common in the soil and reacts with urea causing it to move into a volatile form, making it subject to atmospheric loss.
    - **Coated Fertilizers:** These fertilizers, most commonly urea, have been coated with a polymer, that slowly degrades in the soil, allowing it to release into the soil profile later in the season.
    - **Humic Acids:** These products are controversial as nitrogen stabilizers, but have seen a lot of success in recent years. Humic acids do not actually inhibit any biological process in the soil and therefore have been excluded from being labeled as stabilizers by some state Departments of Agriculture. However, humic acid is one of the active components of organic matter that acts as a receiving point for holding onto nutrients. A humic acid product artificially changes the CEC immediately around the fertilizer molecule, providing a bonding site for the fertilizer molecule to latch onto and increasing the stability of that nitrogen molecule in the soil profile.

- **Nitrogen source:** Some nitrogen sources have a greater potential for loss than others:
    - **Anhydrous Ammonia:** Anhydrous ammonia can be a stable fall-applied option if some conditions, such as soil moisture and temperature, are favorable. Anhydrous ammonia will also kill most of the biology in the application furrow. It will take time for those biologicals to move back into the furrow from surrounding soil.
    - **Urea:** Urea is a very popular form of nitrogen. It can be particularly sensitive to loss if soil conditions are not ideal and if stabilizers are not used. Ideally, it would be applied with some kind of strip till equipment.
    - **Ammonium Nitrate:** Ammonium nitrate is an extremely stable form of dry fertilizer. Most often it is difficult to source as there are significant restrictions on its storage and transport compared with other nitrogen fertilizer sources.

Action Plan:

When considering a fall nitrogen application, it is important to think about how this practice can work in the farming operation and what factors need to be in place to make the fall nitrogen application successful.

1. What kind of soil conditions exist? Consider temperature, moisture, soil texture, CEC and organic matter levels.
2. What types of application options are available? Can the application be done in a timely manner where the weather-related soil conditions will allow? Sometimes getting the right weather window is the most difficult part of a fall-applied nitrogen program.
3. What nitrogen fertilizer sources are available? Is there is a good stable source that can be applied with a compatible stabilizer?

If the grower can answer all of these questions and feel confident that they have a stable, readily available nitrogen source for their crop in the spring, then fall nitrogen fertilizer applications could be a valuable cost and time saving practice on their farm.

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Summary:

When considering fall-applied nitrogen, it is important to take into consideration multiple factors. Soil conditions, application methods, and fertilizer sources will determine whether a fall application is advisable. If it is practical and safe to apply fall nitrogen, growers can capitalize on more efficient use of field time and potential cost savings.

Resources

Consequences of Fall-Applied N | CropWatch | University of Nebraska–Lincoln

Fall Fertilizer Nitrogen Application | Integrated Crop Management | Iowa State University

Wait, Consider Your Options Before Applying Nitrogen This Fall | University of Minnesota

Strip Till for Field Crop Production | North Dakota State University

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